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ABSTRACT

Well-constructed Information Management Systems (IMSs) are designed specifically to allow for the unobtrusive and automatic acquisition of data describing the key operations associated with the interlocking cycle of relationships between curriculum, instruction, and assessment. This paper argues that IMS software is an essential element to be integrated into the conceptualization, adoption, and maintenance of any curricula and instructional processes that are designed or implemented. Good responsive software design allows for the establishment of relationships among curriculum elements, instructional process, and assessment and evaluation. Moving toward outcomes-based education will help schools monitor their performance more effectively, but realizing this goal requires heavy demands of teachers and administrators, demands that can be alleviated through IMSs. The new information technology available can assist in the transformation of schools for the future. (Contains one figure and eight references.) (SLD)

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INFORMATION PROCESSING AND THE MANAGEMENT OF CURRICULUM, TEACHING AND LEARNING

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Information Processing and the Management of Curriculum, Teaching and Learning

The significance of the latent power embodied in accessing and using information in education has been developing and accelerating over the course of the last two decades and is well recognised, if not universally addressed, by schools and school systems. Following the shift from industrial-based to technological-based economies, within a global information society, those who can access information, transform information and create information are substantially advantaged by all the indices of success in the post industrialised state, while those who cannot create and transform information are increasingly dependent on those who can.. Marshall McCluhan has pointed out that new technologies construct a totally new environment and that this radically alters the way we use our senses and thus the way we act and react to things. On this basis, the restructuring that necessarily occurs as a consequence of introducing new technology enters practically every facet of our lives. Changes come, therefore, because of the application of new technologies and it does not matter so much about the details of the content. The medium is the message. The inevitable transition to a computer based classroom offers major challenges and new opportunities for teaching and learning, empowering us to break the lock of structures and the inertia of tradition that has tended to constrain change managers to accept these as givens in their efforts to reform schools and education systems (Carter and O'Neill, 1995).

Information the key

In spite of the huge, and continuing, expenditure of resources in time, money and human endeavour recorded in an enormous body of literature on educational change, it has not been noteworthy to date in bringing about changes of the order and scale required to have a noticeable and durable effect on school systems and educational practice. Generally the history of educational reform is one in which, with a few notable exceptions, we have persisted with the use of change models and strategies

which have been shown at best to be ineffective (Cuban, 1990). Notwithstanding the fact that current the educational reform movement seeks to change the balance, cumulative change efforts appear not to have met with a great deal of success where it counts most - behind the classroom door. There is an inherent danger in the current round of educational reforms that, if it becomes driven by the urge for scientific management, and from an 'over the shoulder' perspective, organisational and system structures may drive curriculum and instructional design when in fact the organisation in which a curriculum is to be implemented is part of the design itself (Carter 1993a).

Traditional curriculum models, if they worked at all in guiding practice, did not take into account one of the major realities of life very obvious to those who administer and teach in schools. It is the generation, flow and management of information that in the past has substantially acted as a bottleneck to, rather than enhancing the implementation of, curriculum and innovation for school improvement and the raising of school achievement in line with individual entitlements and society's expectations. The basis for conceptualising and integrating curricula with both their internal and external environments lies in, and increasingly must rely on, information management to guide and inform design and implementation decisions made on behalf of an increasingly complex society and its stringent mandates for schooling.

Creating a curriculum now and for the next century requires us to think about the transformation of schools in seeking justifiable ends based on a vision of the future or alternative futures that we currently hold. The potential use of technology to assist in realising alternative futures in education seems to have been addressed in a somewhat fragmentary manner in debates concerning current educational reforms. While not wishing to presume that information management is an exclusive consideration in school improvement and change, a number of indicators suggest that information overload is likely to be a health hazard to those who manage and populate schools now and in the future. Diagnosis and treatment **requires** the application of new

information technology to bring the current overload back to manageable and human proportions so that relevant and timely information, affecting a particular issue or problem of immediate practical concern, can be utilised in arriving at decisions on behalf of students (Carter and Burger, 1994). Through the application of appropriate technology to aid their decision making, teachers and administrators may retain more of a sense of control over the processes of change which seemingly envelop them. In this regard, it is useful to distinguish between technology specifically designed for the task of education, such as CAI packages, and the use of technology to make education possible. Information management technology is a case of the latter.

Well constructed Information Management Systems (IMSs) are designed specifically to allow for the unobtrusive and automatic acquisition of data describing the key operations associated with the interlocking cycle of relationships between curriculum, instruction and assessment (Hextall, 1988). A variety of data are crucial to determining program effectiveness and can serve to guide school improvement processes. Accountability, in the sense of being able to define precisely and show relationships between system variables and desired outcomes, proves to be an important but elusive task without recourse to technology to meet the increased societal expectations of schools and 'value for money' for the educational resources expended. By acquiring skills in the use of IMSs integrating data on curriculum, state and national guidelines, attendance, discipline and student demographics practitioners can begin to identify and understand those relationships and patterns that contribute to overall system improvement.

Going 'on-line'

At the junction of instruction with learning the introduction of the microcomputer together with advances in communications technology provides us with the potential to revolutionise both, as well as the organisational structures in which they conventionally take place. In short the computer, ***when interacting with an informed***

mind, acts as a magnifier of human capacities that allows us to perceive yet further possibilities previously beyond our comprehension. The intellectual tools to support instructional leadership through the management of information to guide and inform data-based decision making are already becoming available at affordable prices. Sophisticated IMSs which combine those functions that lie at the heart of schooling, such as curriculum development, instruction, evaluation and assessment, allow for the formation of information rich environments with great transformative potential.

For example, the form a curriculum takes is not simply two dimensional in its scope and sequence, except perhaps in its documented form. The curriculum as lived out by students in schools and classrooms is multi-dimensional and thus two-dimensional models appearing in a range of curriculum documents do not, and cannot, adequately represent the dynamic nature of learning context, curriculum processes and associated knowledge structures. To be responsive to these, the curriculum of each school has to be locally crafted in order to capitalise on local talents, with local insights in order to meet local needs. Sophisticated IMSs enables instructional leaders to determine the curriculum scope and sequence they desire, while enabling each of their teaching staff to be actively engaged in curriculum development activities in an on-going way.

In information rich environments, on-line curriculum guides become live working documents as educators monitor, adapt and refine curriculum events on a daily basis. For outcome evaluations, supervision and accountability purposes, administrators can ascertain the extent to which a particular teacher uses a variety of instructional activities in his or her teaching, or the extent to which curriculum and its implementation matches state guidelines, standards and benchmarks, or other external references. To illustrate this, the curricular structure for a particular IMS for use in outcomes-based programs is shown in Figure 1.

FIGURE 1 ABOUT HERE

Because the IMS automatically records detailed audit trails as staff members use it, supervisors can obtain profiles of how the performance of students and /or teachers are changing, by viewing sets of records accumulated unobtrusively through the daily operations of the school over selected periods of time.

There are two ways of using technology to achieve these environments. One is for the purpose of *automating*: the other for *informating*. While there are some who clearly seek to use technology for the former purpose, it tends to become mechanistic and to isolate the human element from the process itself. Automating then is not a satisfactory means for supporting teachers and administrators and for educational problem solving. To 'informate', however, is to empower educators as professionals. It is in this context that instructional leaders can work with staff in order to resolve the question of what information has to be readily available and easily accessible for them to both understand and execute certain educational processes and curricular events.

New generation information technology can assist tremendously with the design, development, evolution and alignment of curricula across system to classroom levels of schooling. It provides, for example, the means for monitoring which curriculum elements are included in daily lesson plans, student grouping practices; 'at-risk' students; the development of teacher made learning materials; the management of material resources; the form of assessment programs across different time spans and subject areas, and curriculum alignment to external references, benchmarks and standards on a continuous, routine and substantially unobtrusive basis (Carter, 1993b).

Through the total integration of all school functions, the new generation of instructionally driven Information Management Systems (IMSs) represent a

marked departure from those Management Information Systems (MISs) currently used essentially for administrative regulation; accessible to only a few administrative staff and underpinned by notions of scientific management.

Instructional Process

Generally speaking, there is little argument among professionals that helping people learn, grow, and develop in order to realise their full potential is what a good general education is about. How well this is achieved in the context of national goals depends on how well teachers are motivated to work for constant improvement, and are themselves provided with the resources and incentives to grow and develop as learners concerning their own professional practice. In this regard Sarason (1990) makes an observation to the effect that if teachers as learners do not perceive that the appropriate conditions for their own growth obtain, they cannot create and sustain them for their students. From this point of view, student learning is also a function of teacher learning, development and growth.

For learning to be made more effective it has to be more closely integrated across content areas. To this end we need to get a 'whole curriculum' perspective in a hurry concerning the vertical sequences of learning activities and their integration across classrooms at particular grade levels. Further, the monitoring of student progress towards the achievement of particular outcomes has to take place across different subject matter, different learning contexts and in using different instructional processes in which time is not held constant as students progress at different rates. This is a most difficult thing to accomplish and to demonstrate in practice, but we now have the software tools available to resolve some of the problems of curriculum correlation, and in directing learning sequences and monitoring and reporting their effects commencing from students' initial entry to school to their leaving as adults.

It is taken as axiomatic, and supported by the research on schools and teacher effectiveness, that instruction makes a difference, and, for the full potential of this to be realised, teachers must be able to capitalise on new knowledge, exercise data-based professional judgements, and acquire intimate knowledge of the changing needs of the learner in the exercise of their own creativity and spontaneity. While a well designed curriculum aligned with appropriate instructional processes is regarded as fundamental to helping each student achieve mastery of the objectives, slavish adherence to the textbook and detailed attention to every objective in the curriculum is **not** a means to achieving the desired outcomes. In effect it is likely to work against the desired result of raising student achievement.

For the instructional context and learning environment to be rich, a process orientation in which a variety of instructional strategies must be present, with students afforded the opportunity to read and discuss much more widely than is directly required for the immediate achievement of the objectives, is also required. It is also important to realise that it is not necessary and even ill advised to seek to control all the activities that take place under instructional processes, but to be able to ascertain their nature at will, and to direct them differentially to learners as needed, and in the full knowledge of the extent to which external agencies are also influencing and guiding instructional processes.

With the curriculum on-line, data accumulates unobtrusively through the normal operation of the school and the on-going processes of education. Accumulated data that 'captures' the functions and operations of the school from, curriculum development, lesson planning, student, parent and teacher, and assessment points of view, and cross-referenced to external standards can now be managed with a pedagogically driven IMS. Relational data-base technology makes information readily accessible to guide and inform decision making serving a variety of needs and purposes. The upper limit of accessing accumulated data in a variety of forms rests

with the ability of the teacher, administrator, parent ... to interrogate the IMS in order to call up the accumulated information they are seeking in a form they require.

Archived data ordinarily lost to the school and the system, but now unobtrusively and continuously accumulated through the normal operation of school routines, can be queried, probed and structured in ways that support and enable formal inquiry into the operation and functioning of the school, including its intellectual, social, economic and organisational aspects as a form of problem finding, and problem solving. Obvious uses here, for example, are for the management and utilisation of the schools' material resources; the conduct of program evaluations and audit trails; supervision of beginning teachers and the induction of new staff; performance appraisal (where access to on-going data can readily support formative processes) and the tracking of 'at risk' students. Research in the sense used here implies increasing the sensitivity of organisations that can learn, populated by professionals who, in the service of their clients, are students of their own professional practice.

An Example of New Generation IMS Software.

The software described below was developed initially in its prototype form at Texas A&M University. IMSeries^{tm} consists of a set of powerful information management tools for educators and is among the first of a new generation of instructional management systems exhibiting the characteristics described above. In one integrated set of tools it enables users to manage critical information at each stage of the entire instructional and curriculum design process. The package is designed to provide educators with a powerful set of information tools that they can use to:

- capitalise on their training, skills and experience as they plan, deliver, and assess instruction;

- co-ordinate planning and assessment with colleagues and share ideas and expertise;

- determine, improve and manage the quality of instructional processes, and outcomes;

- build longitudinal databases which can serve as references for research on instructional effectiveness and for program development (for both curriculum and staff);

- increase the flexibility of instructional programs by enabling educators to manage complex data;

- track performance of any student over time against any curricular or instructional reference point;

- respond to accountability concerns without giving up professional abilities, the need to make flexible decisions, or the desire to be creative; and,

- allow all those who have vested interests in the quality of instructional programs to participate in, and review information associated with those programs.

A brief description of each of the four modules that comprise the IMSeries software package follows.

Curriculum Developer (CD)

Educators are using CD to design, review, analyse, align, maintain, and generate reports concerning their curricula. Once these are built, educators can align them

dynamically with any combination of external standards (eg. state guidelines, outcome statements, or standards from professional organisations). With CD, teachers and administrators can view their curricula from an unlimited number of perspectives, because analyses can be performed across any boundaries that may exist in its structure (see Figure 1).

Thus powerful tools exist to help practitioners rearrange and update curricula. Use of these can encourage restructuring curricula into innovative formats. Even though extensive power remains in the hands of the coordinator to determine the scope, sequence, structure, and philosophy around which the curricula are built, CD enables practitioners to align their curriculum with external standards for accountability, quality control, and auditing functions.

Lesson Planner (LP)

Teachers can use LP to manage the massive amounts of information which they need to be able to access and manipulate to design and deliver the high quality instruction that effective educators have always struggled to provide. They can also use LP to assess the results of their decisions; a necessity for any profession. When it is installed in a network environment, teachers can share information with each other and select from, or extend, curriculum options that are available to other teachers and their students.

With this package, teachers can plan and monitor instruction on a class, subgroup, or individual learner basis. Questions about what has been taught, including to which students, how, when, and how often, can be ascertained and analysed at any time. LP also enables teachers to flexibly assess, manage, analyse, and report student performance. Performance can be analysed and reported by averages, performance profiles, and through electronic portfolios.

Student Data Manager (SDM)

Student Data Manager enables teachers to integrate extensive demographic, attendance, and discipline reporting, accounting, and analysis with instructional planning, delivery, and performance. By this means performance is monitored as it naturally occurs and is not removed from the context of teaching and learning and other aspects of concern to the processes of feedback and counselling.

Educational Researcher (ER)

Educational Researcher serves as a set of tools which educators can use to examine complex data sets that are generated continuously and unobtrusively as the IMS is being used. It is intended to be useful as a means of helping practitioners and researchers determine what is or is not working, and how well or poorly. In addition it serves as a research tool to help educators generate and test hypotheses regarding how and why certain practices may or may not be working.

Solving Some Practical Problems

IMS relational database technologies can be used to maintain connections between and among various information types. For example, particular students and elements of curricula are linked to teachers via the sections they teach, and lesson plans link students with dates, times, teachers, and specific curriculum events, for example. Through *ad hoc* queries, practitioners are able to obtain reports on command and answers to their questions as these arise. Some typical questions are listed below.

Teacher information

- To what extent does the teacher's instruction contemplate the district or state scope and sequence recommendations and guide-lines?

- Does the teacher's instruction include a broad range of objectives covering basic as well as higher order statements of purpose?
- Do the evaluation methods used by the teacher align with instruction that is delivered, and does the teacher use a variety of methods to evaluate student performance?

- How is the teacher adjusting instruction by altering content or grouping strategies to match student characteristics and needs?

Student

- Do instructional records indicate that students are being given opportunities to reinforce learning via remediation and/ or enrichment activities?

- Which components of the curriculum have been delivered to which students, by whom, how often and when?

- Is there evidence that evaluation methods reflect student capabilities?

- Are low SES students receiving the same quality of instruction as other students?

Curriculum

- To what extent are core curricula (both scope and sequence) being included in classroom instruction?

- How much variety is there in instructional activities and resources which are available for inclusion in lesson plans?

- Which elements of the curricula are not being used by any teachers in their instruction?

Lesson Plans

- Are cross references (eg. state and local curriculum guide-lines) being integrated into lesson plans?

- Are students being evaluated on the instruction they are actually receiving?

- How do different teachers approach long-term instruction when addressing similar content?

Conclusion

In this paper it has been argued that IMS software is an essential element to be integrated into the conceptualisation, adoption and maintenance of any curricula and instructional processes that we care to design and implement, allowing for stringent accountability criteria to be met in the provision of a general education for all students that can be justified in its own terms. Good responsive software design allows for the establishment of relationships between curriculum elements, instructional process and assessment and evaluation thereby facilitating alignment between each of them and with external standards. Moving toward outcomes-based education will help schools monitor their performance more effectively and thereby improve the quality of teaching and learning. Realising this vision, however, is likely to place heavy demands on teachers and administrators and requires the exercise of high quality leadership within information rich environments.

The use of a new generation of software tools with great transformative potential, such as those described above, may help us break the lock of at least some of the constraints that have previously inhibited us in bringing about classroom change and

school improvements. Realising this vision is likely to place heavy demands on curriculum management and require the exercise of high quality leadership (Carter, Glass and Hord, 1993). As already asserted in this paper, and developed as one of its main themes, we now have a new generation of information technology available, which, when allied to human capacities and a vision of the future that we hold, can assist the transformation of schools so that, in creating our future the dimensions of change take on a different meaning.

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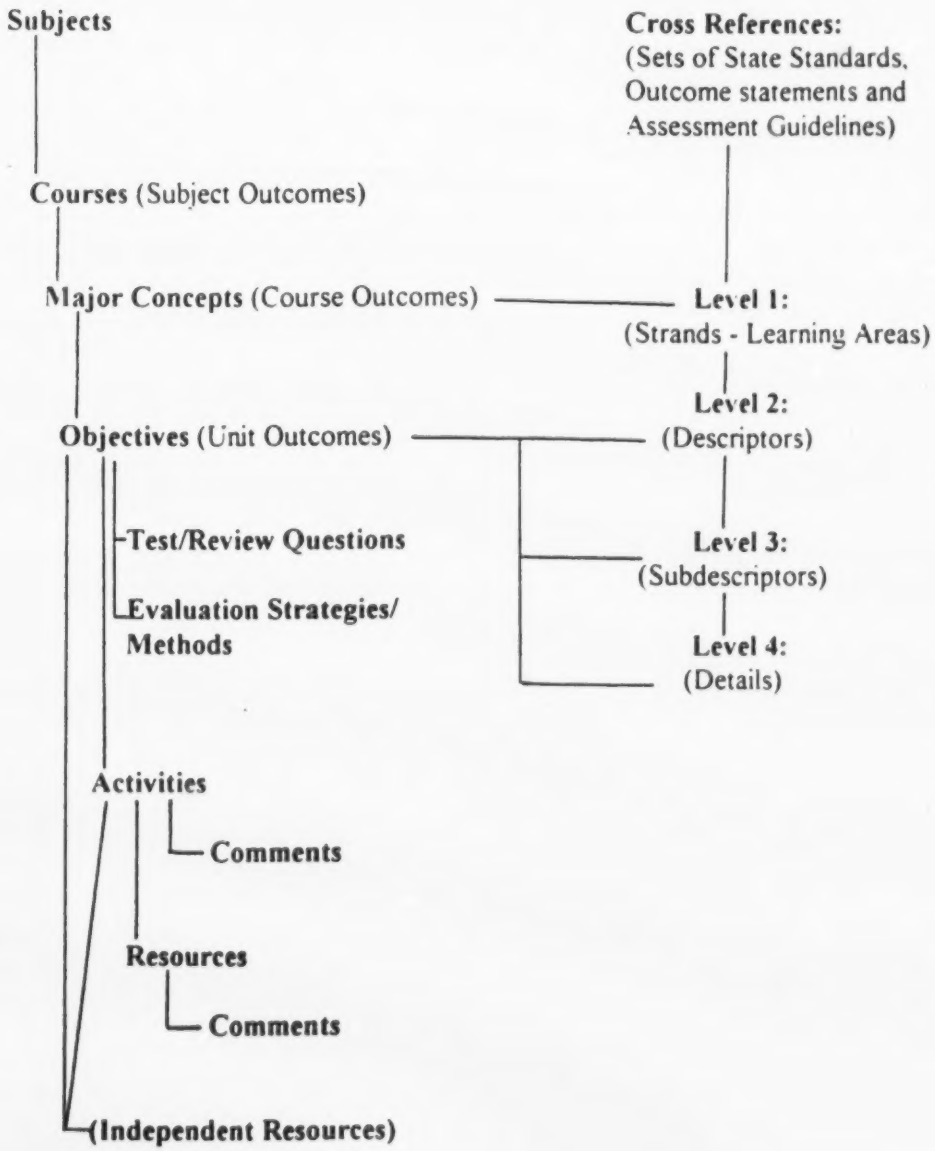
Figure 1

A Hierarchical Arrangement of Curriculum Elements for Information Management


Subjects
Cross References:
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Courses (Subject Outcomes)
Major Concepts (Course Outcomes)
Level 1:
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Level 2:
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Activities
Comments
Resources
Comments
(Independent Resources)